IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

REALTIME ADAPTIVE STREAMING LLC, Plaintiff, v. HAIVISION NETWORK VIDEO INC., Defendant.	Case No. 6:19-cv-00441 JURY TRIAL DEMANDED

COMPLAINT FOR PATENT INFRINGEMENT

This is an action for patent infringement arising under the Patent Laws of the United States of America, 35 U.S.C. § 1 *et seq.* in which Plaintiff Adaptive Streaming LLC ("Plaintiff" or "Realtime") makes the following allegations against Defendant Haivision Network Video Inc. ("Defendant" or "Haivision").

PARTIES

1. Realtime is a Texas limited liability company. Realtime has a place of business at 66 Palmer Avenue, Suite 27, Bronxville, NY 10708. Realtime has researched and developed specific solutions for data compression, including, for example, those that increase the speeds at which data can be stored and accessed. As recognition of its innovations rooted in this technological field, Realtime holds multiple United States patents and pending patent applications.

2. On information and belief, Defendant is a Delaware corporation with its principal place of business at 13975 W Polo Trail Drive, Lake Forest, Illinois 60045-5119. Defendant resides in this District because it is incorporated in Delaware. Defendant offers its products and/or services, including those accused herein of infringement, to customers

and potential customers located in Delaware and in this District. Defendant Haivision Network Video Inc. may be served with process through its registered agent for service at: Corporation Service Company, 251 Little Falls Dr., Wilmington, DE 19808.

JURISDICTION AND VENUE

3. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has original subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

4. This Court has personal jurisdiction over Defendant in this action because Defendant has committed acts within this District giving rise to this action and has established minimum contacts with this forum such that the exercise of jurisdiction over Defendant would not offend traditional notions of fair play and substantial justice. Defendant has also committed and continue to commit acts of infringement in this District by, among other things, offering to sell and selling products and/or services that infringe the asserted patents.

5. Venue is proper in this district, *e.g.*, under 28 U.S.C. § 1400(b). Defendant has transacted business in this District and has committed acts of direct and indirect infringement in this District. Defendant has regular and established place of business in this District, including, e.g., at 4005 Banister Ln, Austin, TX 78704. *See* https://www.haivision.com/about/press-releases/haivision-moves-montreal-headquarters-to-accommodate-continued-growth-advanced-research-and-product-development/ ("Serving the global market, the company has recently expanded its headquarters in Chicago and offices in Hamburg, Germany, and also has regional offices in Portland, Austin, Washington D.C., and Atlanta.").

COUNT I

INFRINGEMENT OF U.S. PATENT NO. 8,934,535

6. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

7. Plaintiff Realtime is the owner by assignment of United States Patent No. 8,934,535 ("the '535 patent") entitled "Systems and methods for video and audio data storage and distribution." The '535 patent was duly and legally issued by the United States Patent and Trademark Office on January 13, 2015. A true and correct copy of the '535 patent is included as **Exhibit A.**

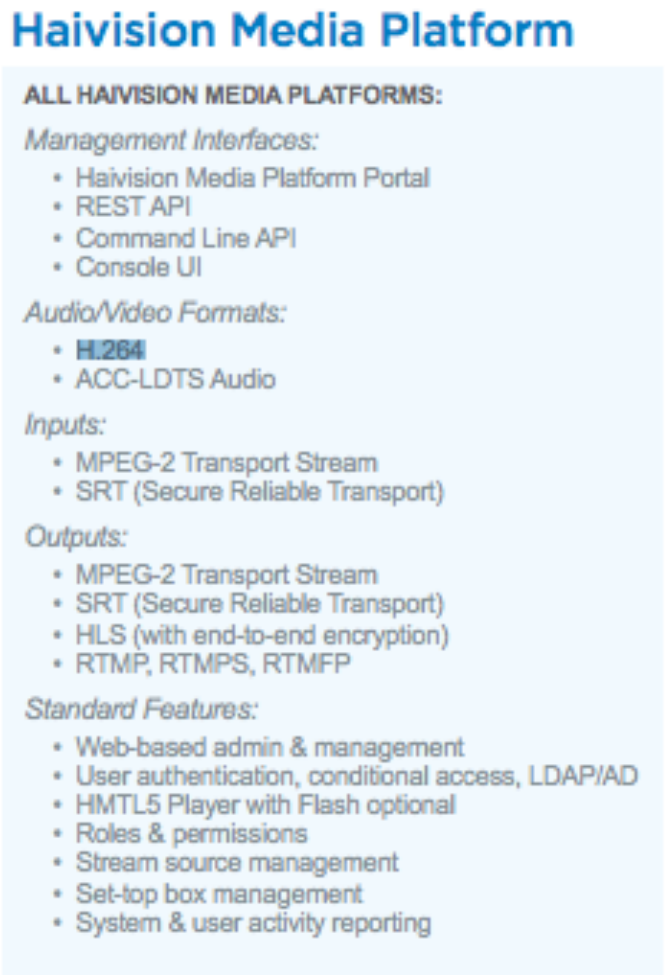
8. On information and belief, Defendant has made, used, offered for sale, sold and/or imported into the United States products that infringe the '535 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendant's video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '535 patent ("Accused Instrumentalities")

9. On information and belief, Defendant has directly infringed and continue to infringe the '535 patent, for example, through its own use and testing of the Accused

Instrumentalities, which when used, practices the method claimed by Claim 1 of the '535 patent, namely, a method, comprising: determining a parameter or attribute of at least a portion of a data block having audio or video data; selecting an access profile from among a plurality of access profiles based upon the determined parameter or attribute; and compressing the at least the portion of the data block with one or more compressors using asymmetric data compression and information from the selected access profile to create one or more compressed data blocks, the information being indicative of the one or more compressors to apply to the at least the portion of the data block. Upon information and belief, Defendant uses the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

10. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.,* https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

11. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See* page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:



Haivision Media Platform

ALL HAIVISION MEDIA PLATFORMS:

Management Interfaces:

- Haivision Media Platform Portal
- REST API
- Command Line API
- Console UI

Audio/Video Formats:

- H.264
- ACC-LDTS Audio

Inputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)

Outputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)
- HLS (with end-to-end encryption)
- RTMP, RTMPS, RTMFP

Standard Features:

- Web-based admin & management
- User authentication, conditional access, LDAP/AD
- HMTL5 Player with Flash optional
- Roles & permissions
- Stream source management
- Set-top box management
- System & user activity reporting

12. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):

13. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

High Quality, High Density, High Profile H.264 Encoder & Decoder

Haivision's award-winning Makito X encoder and decoder transports secure, low latency, HD video over any network at extremely low bitrates. Available as an ultra compact SDI or DVI appliance with optional fixed or removable storage, or within a high density 1RU or 4RU chassis. The Makito X is ideal for live, interactive and bandwidth constrained applications.

Highest Quality To maximize video quality over your network, the Makito X supports High Profile H.264 encoding. Tuned to excel in low bandwidth environments, the Makito X gives you twice the quality or uses half the bandwidth compared to other enterprise encoders. Matched with the Makito X Decoder to provide extremely low end-to-end latency, the Makito X delivers pristine quality at sub-2 Mbps bitrates. The Makito X is ideal for video distribution within a facility, to connect facilities or support remote video contribution, to deliver performance video over satellite connections and across the Internet.

14. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the

quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Features	Benefits
Low end-to-end latency	Supports mission-critical distribution and interactive communication challenge
4 HD encoding engines	Flexible encoding & compression, adapting to different network environments & applications
Multiple destinations per stream	Target different systems, networks, users, and platforms individually
Highly efficient encoding	Up to twice the quality or half of the bandwidth, using High Profile H.264
12 HD 1080p60 channels in 1RU	Highest density available reducing cost, footprint, and energy consumption
AES 256 bit encryption	Secure unicast or multicast end-to-end video distribution
Metadata support	Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources
SRT and FEC	Maintain video quality over unqualified networks and low cost public internet connections
Integrated with Furnace, InStream and CoolSign	Complete end-to-end video solution

15. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

VIDEO ENCODING/DECODING
Compression Standard:
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
Bit Rates:
SD/HD from 32 kbps to 25 Mbps
Rate Control:
CBR/VBR
Latency (encoder only):
Less than 55ms

IP NETWORK INTERFACES
Standard:
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
Connector:
RJ45
Networking Protocols:
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

16. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Makito X Product Portfolio & Ordering Information **

Makito X Single SDI	S/B-292E-HDSDI1	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel
Makito X Dual SDI	S/B-292E-HDSDI2	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels
Makito X DVI	S/B-292E-DVI	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component
Makito X Decoder Single Channel	S/B-292D-HD1	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI
Makito X Decoder Dual Channel	S/B-292D-HD2	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI

17. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor

MONTREAL and CHICAGO — May 19, 2010 — Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

About Haivision Network Video

Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

18. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

See https://www.haivision.com/products/kb-series/:

BEST VIEWING EXPERIENCE

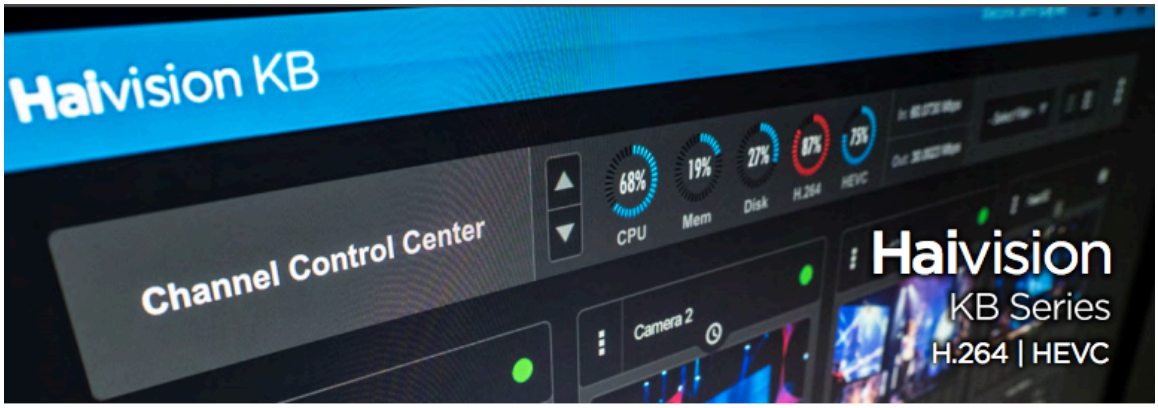
H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

19. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion

of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:



H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

Hardware Acceleration & ABR Cascades The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

Best Viewing Experience on Every Device With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

Get the Most Out of your Uplink Connection to the Cloud When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

Features	Benefits
H.264/HEVC encoding/transcoding	High efficiency video compression over constrained networks for live events contribution
H.264/HEVC ABR Cascades	Seamless viewing experience at the player level with dynamic bitrate/resolution tuning
SRT protocol	AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder
Extensive CDN Support	Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services
608/708 closed captioning	Support digital television closed captioning standards
Small Form Factor (option)	High powered processing in a portable appliance with the KB Mini
360-degree Virtual Reality (option)	Power virtual reality viewing experiences with the KB 4K

20. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

Flexible Deployment Options The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K H.264/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

21. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard"

("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

TechSpecs KB Series

KB ENCODER/TRANSCODER SERIES

Linux-based, optimized for 64-bit computing and *multicore processing*

Validated CDNs:
- Akamai Certified for RTMP/HLS/MPEG-DASH
- Limelight (StreamAnywhere and MMDLive)
- CDN providers using Adobe Media Server (AMS)
- CDN providers using Wowza servers (with or without secure URL param authentication) and more

Video Encoding

Video Encoding/Compression Standard:
- H.264, HEVC/H.265

Video Input Compression/Decoding:
- MPEG-2, H.264 and HEVC

Profiles:
- H.264: High, Main, Baseline
- HEVC: Main

Bit Rates:
- up to 50Mbps

Rate Control:
- CBR

Video Sampling:
- up to 4:2:2

Audio Encoding

Compression Standard:
- AAC-LC/HE

Bit Rates:
- up to 512 Kbps

Network Outputs Protocols
- SRT/M2TS
- RTMP
- HTTP Live Streaming (HLS)
- MPEG DASH
- UDP (Unicast/Multicast)

File Output
- H.264 MP4
- HEVC MP4

KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE

Video/Audio Inputs:
- One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
- One IP H.264 or HEVC input support up to 1080p60

Stream Outputs:
- H264/HEVC: 1080p30 ABR cascade encode (1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimension:
- 2.49 lbs (1.13 kg)
- 1.41" H x 7.16" W x 7.01" D
- (3.6 cm H x 18.2 cm W x 17.8 cm D)

Power:
- 1x External 90W fanless power adapter

Recording storage capacity:
- Over 200 GB

KB HD ENCODER/TRANSCODER SERVER

Video/Audio Inputs:
- Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
- 8 channels of audio per input

Stream Outputs:
- HEVC: Up to one 1080p30 encode per input
- Or H.264: Up to one 1080p60 encodes per input
- Or H.264 ABR cascade: Up to one 1080p30 encodes per input
- (1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimensions:
- 36.9 lbs (16.7 kg)
- 1.68" H x 18.98" W x 27.57" D
- (4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
- Dual power 550W

System:
- 1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

Audio/Video capture card:
- 2 Network Interfaces (NIC)

Recording storage capacity:
- Over 400 GB

KB 4K ENCODER/TRANSCODER

Video/Audio Inputs:
- Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
- 16 channels of audio per input

Stream Outputs:
- With one 4K UHD input:
- HEVC: Up to one 2160p60 encode
- H.264: Up to one 2160p30 encode
- H.264 ABR cascade: Up to 1080p30 (1080p, 720p, 480p, 360p, 270p, 180p)

With up to four 1080p60 inputs:
- HEVC: Up to one 1080p60 encode per input
- H.264 ABR cascade: Up to 1080p30 (1080p, 720p, 480p, 360p, 270p, 180p) per input

Weight and Dimensions:
- 36.9 lbs (16.7 kg)
- 1.68" H x 18.98" W x 27.57" D
- (4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
- Dual power 495W

Recording storage capacity:
- Over 400 GB

22. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

KB Product Portfolio & Ordering Information **

KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance	S-KB-SFF2-1	1 baseband capture up to 1080p30 or 1 IP input up to 1080p60
KB Encoder/Transcoder Server	S-KB-1/2/4	KB Enterprise Class H.264 & HEVC SD/HD
KB 4K Encoder/Transcoder	S-KB-4	KB Enterprise Class UHD Encoding/Transcoding Appliance
KB Mini Server Rack - Single Unit	RU-SFF-1	Rack mount for single KB Mini appliance
KB Mini Server Rack - Dual Unit	RU-SFF-2	Rack mount for two KB Mini appliances

23. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:

Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming

MONTREAL, CANADA – APRIL 25, 2017 – Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

24. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

4. H.264 profiles and levels

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

See https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

Level	Max decoding speed		Max frame size		Max video bit rate for video coding layer (VCL) kbit/s			Examples for high resolution @ highest frame rate (max stored frames) Toggle additional details
	Luma samples/s	Macroblocks/s	Luma samples	Macroblocks	Baseline, Extended and Main Profiles	High Profile	High 10 Profile	
1	380,160	1,485	25,344	99	64	80	192	176×144@15.0 (4)
1b	380,160	1,485	25,344	99	128	160	384	176×144@15.0 (4)
1.1	768,000	3,000	101,376	396	192	240	576	352×288@7.5 (2)
1.2	1,536,000	6,000	101,376	396	384	480	1,152	352×288@15.2 (6)
1.3	3,041,280	11,880	101,376	396	768	960	2,304	352×288@30.0 (6)
2	3,041,280	11,880	101,376	396	2,000	2,500	6,000	352×288@30.0 (6)
2.1	5,068,800	19,800	202,752	792	4,000	5,000	12,000	352×576@25.0 (6)
2.2	5,184,000	20,250	414,720	1,620	4,000	5,000	12,000	720×576@12.5 (5)
3	10,368,000	40,500	414,720	1,620	10,000	12,500	30,000	720×576@25.0 (5)
3.1	27,648,000	108,000	921,600	3,600	14,000	17,500	42,000	1,280×720@30.0 (5)
3.2	55,296,000	216,000	1,310,720	5,120	20,000	25,000	60,000	1,280×1,024@42.2 (4)
4	62,914,560	245,760	2,097,152	8,192	20,000	25,000	60,000	2,048×1,024@30.0 (4)
4.1	62,914,560	245,760	2,097,152	8,192	50,000	62,500	150,000	2,048×1,024@30.0 (4)
4.2	133,693,440	522,240	2,228,224	8,704	50,000	62,500	150,000	2,048×1,080@60.0 (4)
5	150,994,944	589,824	5,652,480	22,080	135,000	168,750	405,000	3,672×1,536@26.7 (5)
5.1	251,658,240	983,040	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@26.7 (5)
5.2	530,841,600	2,073,600	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@56.3 (5)

25. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

26. Based on the bitrate and/or resolution parameter identified (*e.g.* bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of time for them to compress data than to decompress data. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

	Baseline	Extended	Main	High	High 10
I and P Slices	Yes	Yes	Yes	Yes	Yes
B Slices	No	Yes	Yes	Yes	Yes
SI and SP Slices	No	Yes	No	No	No
Multiple Reference Frames	Yes	Yes	Yes	Yes	Yes
In-Loop Deblocking Filter	Yes	Yes	Yes	Yes	Yes
CAVLC Entropy Coding	Yes	Yes	Yes	Yes	Yes
CABAC Entropy Coding	No	No	Yes	Yes	Yes
Flexible Macroblock Ordering (FMO)	Yes	Yes	No	No	No
Arbitrary Slice Ordering (ASO)	Yes	Yes	No	No	No
Redundant Slices (RS)	Yes	Yes	No	No	No
Data Partitioning	No	Yes	No	No	No
Interlaced Coding (PicAFF, MBAFF)	No	Yes	Yes	Yes	Yes
4:2:0 Chroma Format	Yes	Yes	Yes	Yes	Yes
Monochrome Video Format (4:0:0)	No	No	No	Yes	Yes
4:2:2 Chroma Format	No	No	No	No	No
4:4:4 Chroma Format	No	No	No	No	No
8 Bit Sample Depth	Yes	Yes	Yes	Yes	Yes
9 and 10 Bit Sample Depth	No	No	No	No	Yes
11 to 14 Bit Sample Depth	No	No	No	No	No
8×8 vs. 4×4 Transform Adaptivity	No	No	No	Yes	Yes
Quantization Scaling Matrices	No	No	No	Yes	Yes
Separate Cb and Cr QP control	No	No	No	Yes	Yes
Separate Color Plane Coding	No	No	No	No	No
Predictive Lossless Coding	No	No	No	No	No

See http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

H.264 Entropy Coding – Comparison of Approaches

Characteristics	Variable Length Coding (VLC)	Context Adaptive Binary Arithmetic Coding(CABAC)
• Where it is used	MPEG-2, MPEG-4 ASP	H.264/MPEG-4 AVC (high efficiency option)
• Probability distribution	**Static** - Probabilities never change	**Adaptive** - Adjusts probabilities based on actual data
• Leverages correlation between symbols	**No** - Conditional probabilities ignored	**Yes** - Exploits symbol correlations by using "contexts"
• Non-integer code words	**No** - Low coding efficiency forhigh probability symbols	**Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

entropy_coding_mode_flag selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

27. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its

selection, the asymmetric compressor (CAVLC or CABAC) will compress the video data to provide various compressed data blocks, which can also be organized in a GOP structure.

See https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

Entropy Coding

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

See

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

See http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

28. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

29. On information and belief, Defendant also directly infringe and continue to infringe other claims of the ’535 patent.

30. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

31. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’535 patent.

32. On information and belief, Defendant has had knowledge of the ’535 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendant knew of the ’535 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendant will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’535 patent.

33. Upon information and belief, Defendant’s affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and customary way to infringe the ’535 patent by practicing a method, comprising: determining a

parameter or attribute of at least a portion of a data block having audio or video data; selecting an access profile from among a plurality of access profiles based upon the determined parameter or attribute; and compressing the at least the portion of the data block with one or more compressors using asymmetric data compression and information from the selected access profile to create one or more compressed data blocks, the information being indicative of the one or more compressors to apply to the at least the portion of the data block. For example, Defendant adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendant also induce their customers to use the Accused Instrumentalities to infringe other claims of the '535 patent. Defendant specifically intended and were aware that these normal and customary activities would infringe the '535 patent. Defendant performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the '535 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendant engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendant has induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the '535 patent, knowing that such use constitutes infringement of the '535 patent. Accordingly, Defendant has been, and currently are, inducing infringement of the '535 patent, in violation of 35 U.S.C. § 271(b).

34. Defendant has also infringed, and continue to infringe, claims of the '535 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the '535 patent, and constitute a material part of the invention. Defendant

know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the '535 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendant has been, and currently are, contributorily infringing the '535 patent, in violation of 35 U.S.C. § 271(c).

35. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities' compression features, Defendant has injured Realtime and are liable to Realtime for infringement of the '535 patent pursuant to 35 U.S.C. § 271.

36. As a result of Defendant's infringement of the '535 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

COUNT II

INFRINGEMENT OF U.S. PATENT NO. 9,769,477

37. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

38. Plaintiff Realtime is the owner by assignment of United States Patent No. 9,769,477 ("the '477 patent") entitled "Video data compression systems." The '477 patent was duly and legally issued by the United States Patent and Trademark Office on September 19, 2017. A true and correct copy of the '477 patent is included as **Exhibit B**.

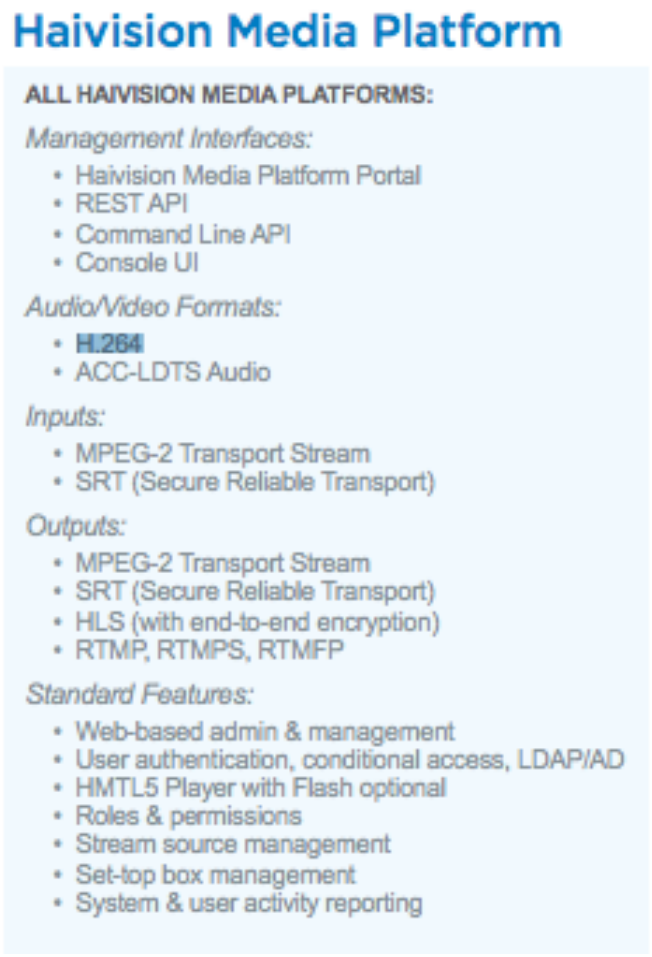
39. On information and belief, Defendant has made, used, offered for sale, sold and/or imported into the United States products that infringe the '477 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendant's video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '477 patent ("Accused Instrumentalities").

40. On information and belief, Defendant has directly infringed and continue to infringe the '477 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the system claimed by Claim 1 of the '477 patent, namely, a system, comprising: a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms, and wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders; and one or more processors configured to: determine one or more data parameters, at least one of the determined one or more data parameters relating to a

throughput of a communications channel measured in bits per second; and select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters. Upon information and belief, Defendant use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

41. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.,* https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

42. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See* page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:



Haivision Media Platform

ALL HAIVISION MEDIA PLATFORMS:

Management Interfaces:

- Haivision Media Platform Portal
- REST API
- Command Line API
- Console UI

Audio/Video Formats:

- H.264
- ACC-LDTS Audio

Inputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)

Outputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)
- HLS (with end-to-end encryption)
- RTMP, RTMPS, RTMFP

Standard Features:

- Web-based admin & management
- User authentication, conditional access, LDAP/AD
- HMTL5 Player with Flash optional
- Roles & permissions
- Stream source management
- Set-top box management
- System & user activity reporting

43. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):

44. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

45. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the

quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Features	Benefits
Low end-to-end latency	Supports mission-critical distribution and interactive communication challenge
4 HD encoding engines	Flexible encoding & compression, adapting to different network environments & applications
Multiple destinations per stream	Target different systems, networks, users, and platforms individually
Highly efficient encoding	Up to twice the quality or half of the bandwidth, using High Profile H.264
12 HD 1080p60 channels in 1RU	Highest density available reducing cost, footprint, and energy consumption
AES 256 bit encryption	Secure unicast or multicast end-to-end video distribution
Metadata support	Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources
SRT and FEC	Maintain video quality over unqualified networks and low cost public internet connections
Integrated with Furnace, InStream and CoolSign	Complete end-to-end video solution

46. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

VIDEO ENCODING/DECODING
Compression Standard:
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
Bit Rates:
SD/HD from 32 kbps to 25 Mbps
Rate Control:
CBR/VBR
Latency (encoder only):
Less than 55ms

IP NETWORK INTERFACES
Standard:
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
Connector:
RJ45
Networking Protocols:
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

47. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product

Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Makito X Product Portfolio & Ordering Information **

Makito X Single SDI	S/B-292E-HDSDI1	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel
Makito X Dual SDI	S/B-292E-HDSDI2	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels
Makito X DVI	S/B-292E-DVI	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component
Makito X Decoder Single Channel	S/B-292D-HD1	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI
Makito X Decoder Dual Channel	S/B-292D-HD2	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI

48. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor

MONTREAL and CHICAGO — May 19, 2010 — Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

About Haivision Network Video

Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

49. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

See https://www.haivision.com/products/kb-series/:

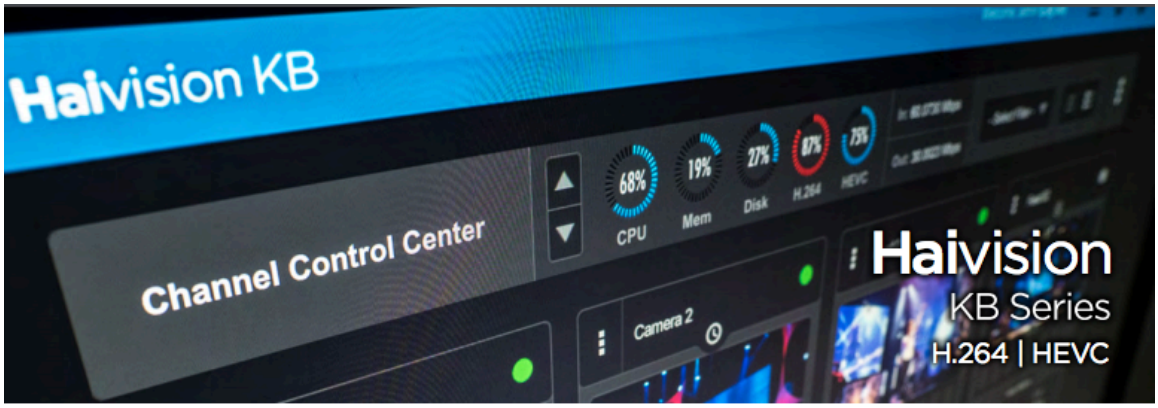
BEST VIEWING EXPERIENCE

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

50. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:



H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

Hardware Acceleration & ABR Cascades The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

Best Viewing Experience on Every Device With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

Get the Most Out of your Uplink Connection to the Cloud When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

Features	Benefits
H.264/HEVC encoding/transcoding	High efficiency video compression over constrained networks for live events contribution
H.264/HEVC ABR Cascades	Seamless viewing experience at the player level with dynamic bitrate/resolution tuning
SRT protocol	AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder
Extensive CDN Support	Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services
608/708 closed captioning	Support digital television closed captioning standards
Small Form Factor (option)	High powered processing in a portable appliance with the KB Mini
360-degree Virtual Reality (option)	Power virtual reality viewing experiences with the KB 4K

51. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

Flexible Deployment Options The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K H.264/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

52. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard"

("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

TechSpecs **KB Series**

KB ENCODER/TRANSCODER SERIES

Linux-based, optimized for 64-bit computing and *multicore processing*

Validated CDNs:
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

Video Encoding
Video Encoding/Compression Standard:
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
Profiles:
H.264: High, Main, Baseline
HEVC: Main
Bit Rates:
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

Audio Encoding
Compression Standard:
AAC-LC/HE
Bit Rates:
up to 512 Kbps

Network Outputs Protocols
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

File Output
H.264 MP4
HEVC MP4

KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE

Video/Audio Inputs:
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

Stream Outputs:
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimension:
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

Power:
1x External 90W fanless power adapter

Recording storage capacity:
Over 200 GB

KB HD ENCODER/TRANSCODER SERVER

Video/Audio Inputs:
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

Stream Outputs:
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)
Power:
Dual power 550W

System:
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

Audio/Video capture card:
2 Network Interfaces (NIC)

Recording storage capacity:
Over 400 GB

KB 4K ENCODER/TRANSCODER

Video/Audio Inputs:
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

Stream Outputs:
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

With up to four 1080p60 inputs:
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 495W

Recording storage capacity:
Over 400 GB

53. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

KB Product Portfolio & Ordering Information **

KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance	S-KB-SFF2-1	1 baseband capture up to 1080p30 or 1 IP input up to 1080p60
KB Encoder/Transcoder Server	S-KB-1/2/4	KB Enterprise Class H.264 & HEVC SD/HD
KB 4K Encoder/Transcoder	S-KB-4	KB Enterprise Class UHD Encoding/Transcoding Appliance
KB Mini Server Rack - Single Unit	RU-SFF-1	Rack mount for single KB Mini appliance
KB Mini Server Rack - Dual Unit	RU-SFF-2	Rack mount for two KB Mini appliances

54. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:

Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming

MONTREAL, CANADA – APRIL 25, 2017 – Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

55. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with

different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

4. H.264 profiles and levels

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

See https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

Level	Max decoding speed		Max frame size		Max video bit rate for video coding layer (VCL) kbit/s			Examples for high resolution @ highest frame rate (max stored frames) Toggle additional details
	Luma samples/s	Macroblocks/s	Luma samples	Macroblocks	Baseline, Extended and Main Profiles	High Profile	High 10 Profile	
1	380,160	1,485	25,344	99	64	80	192	176×144@15.0 (4)
1b	380,160	1,485	25,344	99	128	160	384	176×144@15.0 (4)
1.1	768,000	3,000	101,376	396	192	240	576	352×288@7.5 (2)
1.2	1,536,000	6,000	101,376	396	384	480	1,152	352×288@15.2 (6)
1.3	3,041,280	11,880	101,376	396	768	960	2,304	352×288@30.0 (6)
2	3,041,280	11,880	101,376	396	2,000	2,500	6,000	352×288@30.0 (6)
2.1	5,068,800	19,800	202,752	792	4,000	5,000	12,000	352×576@25.0 (6)
2.2	5,184,000	20,250	414,720	1,620	4,000	5,000	12,000	720×576@12.5 (5)
3	10,368,000	40,500	414,720	1,620	10,000	12,500	30,000	720×576@25.0 (5)
3.1	27,648,000	108,000	921,600	3,600	14,000	17,500	42,000	1,280×720@30.0 (5)
3.2	55,296,000	216,000	1,310,720	5,120	20,000	25,000	60,000	1,280×1,024@42.2 (4)
4	62,914,560	245,760	2,097,152	8,192	20,000	25,000	60,000	2,048×1,024@30.0 (4)
4.1	62,914,560	245,760	2,097,152	8,192	50,000	62,500	150,000	2,048×1,024@30.0 (4)
4.2	133,693,440	522,240	2,228,224	8,704	50,000	62,500	150,000	2,048×1,080@60.0 (4)
5	150,994,944	589,824	5,652,480	22,080	135,000	168,750	405,000	3,672×1,536@26.7 (5)
5.1	251,658,240	983,040	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@26.7 (5)
5.2	530,841,600	2,073,600	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@56.3 (5)

56. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

57. Based on the bitrate and/or resolution parameter identified (e.g. bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of

time for them to compress data than to decompress data. *See*

https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

	Baseline	Extended	Main	High	High 10
I and P Slices	Yes	Yes	Yes	Yes	Yes
B Slices	No	Yes	Yes	Yes	Yes
SI and SP Slices	No	Yes	No	No	No
Multiple Reference Frames	Yes	Yes	Yes	Yes	Yes
In-Loop Deblocking Filter	Yes	Yes	Yes	Yes	Yes
CAVLC Entropy Coding	Yes	Yes	Yes	Yes	Yes
CABAC Entropy Coding	No	No	Yes	Yes	Yes
Flexible Macroblock Ordering (FMO)	Yes	Yes	No	No	No
Arbitrary Slice Ordering (ASO)	Yes	Yes	No	No	No
Redundant Slices (RS)	Yes	Yes	No	No	No
Data Partitioning	No	Yes	No	No	No
Interlaced Coding (PicAFF, MBAFF)	No	Yes	Yes	Yes	Yes
4:2:0 Chroma Format	Yes	Yes	Yes	Yes	Yes
Monochrome Video Format (4:0:0)	No	No	No	Yes	Yes
4:2:2 Chroma Format	No	No	No	No	No
4:4:4 Chroma Format	No	No	No	No	No
8 Bit Sample Depth	Yes	Yes	Yes	Yes	Yes
9 and 10 Bit Sample Depth	No	No	No	No	Yes
11 to 14 Bit Sample Depth	No	No	No	No	No
8×8 vs. 4×4 Transform Adaptivity	No	No	No	Yes	Yes
Quantization Scaling Matrices	No	No	No	Yes	Yes
Separate Cb and Cr QP control	No	No	No	Yes	Yes
Separate Color Plane Coding	No	No	No	No	No
Predictive Lossless Coding	No	No	No	No	No

See http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

H.264 Entropy Coding – Comparison of Approaches

Characteristics	Variable Length Coding (VLC)	Context Adaptive Binary Arithmetic Coding(CABAC)
• Where it is used	MPEG-2, MPEG-4 ASP	H.264/MPEG-4 AVC (high efficiency option)
• Probability distribution	**Static** - Probabilities never change	**Adaptive** - Adjusts probabilities based on actual data
• Leverages correlation between symbols	**No** - Conditional probabilities ignored	**Yes** - Exploits symbol correlations by using "contexts"
• Non-integer code words	**No** - Low coding efficiency forhigh probability symbols	**Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

entropy_coding_mode_flag selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

– If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).

– Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

58. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video data

to provide various compressed data blocks, which can also be organized in a GOP structure.

See https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

Entropy Coding

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

See

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

See http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

59. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

60. On information and belief, Defendant also directly infringe and continue to infringe other claims of the ’477 patent.

61. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

62. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’477 patent.

63. On information and belief, Defendant has had knowledge of the ’477 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendant knew of the ’477 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendant will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’477 patent.

64. Upon information and belief, Defendant’s affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and customary way to infringe the ’477 patent by practicing a system, comprising: a plurality of different

asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms, and wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders; and one or more processors configured to: determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel measured in bits per second; and select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters. For example, Defendant adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendant also induce their customers to use the Accused Instrumentalities to infringe other claims of the '477 patent. Defendant specifically intended and were aware that these normal and customary activities would infringe the '477 patent. Defendant performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the '477 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendant engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendant has induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the '477 patent, knowing that such use constitutes infringement of the '477 patent. Accordingly, Defendant

has been, and currently are, inducing infringement of the ’477 patent, in violation of 35 U.S.C. § 271(b).

65. Defendant has also infringed, and continue to infringe, claims of the ’477 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the ’477 patent, and constitute a material part of the invention. Defendant know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’477 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendant has been, and currently are, contributorily infringing the ’477 patent, in violation of 35 U.S.C. § 271(c).

66. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendant has injured Realtime and are liable to Realtime for infringement of the ’477 patent pursuant to 35 U.S.C. § 271.

67. As a result of Defendant’s infringement of the ’477 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendant’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

COUNT III

INFRINGEMENT OF U.S. PATENT NO. 8,929,442

68. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

69. Plaintiff Realtime is the owner by assignment of United States Patent No. 8,929,442 ("the '442 patent") entitled "System and method for video and audio data distribution." The '442 patent was duly and legally issued by the United States Patent and Trademark Office on January 6, 2015. A true and correct copy of the '442 patent is included as **Exhibit C.**

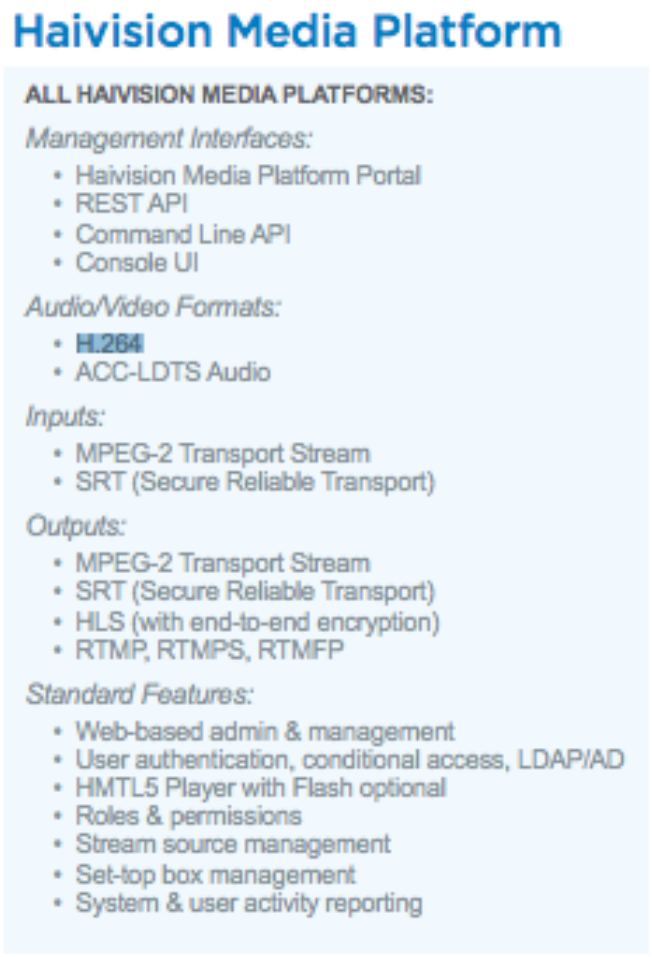
70. On information and belief, Defendant has made, used, offered for sale, sold and/or imported into the United States products that infringe the '442 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendant's video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '442 patent ("Accused Instrumentalities").

71. On information and belief, Defendant has directly infringed and continue to infringe the '442 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the apparatus claimed by Claim 8 of the '442 patent, namely, an apparatus, comprising: a data decompression system configured to

decompress a compressed data block; and a storage medium configured to store at least a portion of the decompressed data block, wherein at least a portion of a data block having video or audio data was compressed with one or more compression algorithms selected from among a plurality of compression algorithms based upon a throughput of a communication channel and a parameter or an attribute of the at least the portion of the data block to create at least the compressed data block, and wherein at least one of the plurality of compression algorithms is asymmetric. Upon information and belief, Defendant use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

72. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.,* https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

73. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See* page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:



Haivision Media Platform

ALL HAIVISION MEDIA PLATFORMS:

Management Interfaces:

- Haivision Media Platform Portal
- REST API
- Command Line API
- Console UI

Audio/Video Formats:

- H.264
- ACC-LDTS Audio

Inputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)

Outputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)
- HLS (with end-to-end encryption)
- RTMP, RTMPS, RTMFP

Standard Features:

- Web-based admin & management
- User authentication, conditional access, LDAP/AD
- HMTL5 Player with Flash optional
- Roles & permissions
- Stream source management
- Set-top box management
- System & user activity reporting

74. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):

75. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

76. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Features	Benefits
Low end-to-end latency	Supports mission-critical distribution and interactive communication challenge
4 HD encoding engines	Flexible encoding & compression, adapting to different network environments & applications
Multiple destinations per stream	Target different systems, networks, users, and platforms individually
Highly efficient encoding	Up to twice the quality or half of the bandwidth, using High Profile H.264
12 HD 1080p60 channels in 1RU	Highest density available reducing cost, footprint, and energy consumption
AES 256 bit encryption	Secure unicast or multicast end-to-end video distribution
Metadata support	Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources
SRT and FEC	Maintain video quality over unqualified networks and low cost public internet connections
Integrated with Furnace, InStream and CoolSign	Complete end-to-end video solution

77. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

VIDEO ENCODING/DECODING
Compression Standard:
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
Bit Rates:
SD/HD from 32 kbps to 25 Mbps
Rate Control:
CBR/VBR
Latency (encoder only):
Less than 55ms

IP NETWORK INTERFACES
Standard:
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
Connector:
RJ45
Networking Protocols:
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

78. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at

Makito X Product Portfolio & Ordering Information **

Makito X Single SDI	S/B-292E-HDSDI1	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel
Makito X Dual SDI	S/B-292E-HDSDI2	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels
Makito X DVI	S/B-292E-DVI	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component
Makito X Decoder Single Channel	S/B-292D-HD1	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI
Makito X Decoder Dual Channel	S/B-292D-HD2	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI

http://www3.haivision.com/datasheet-makito-x:

79. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor

MONTREAL and CHICAGO — May 19, 2010 — Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

About Haivision Network Video
Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

80. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

See https://www.haivision.com/products/kb-series/:

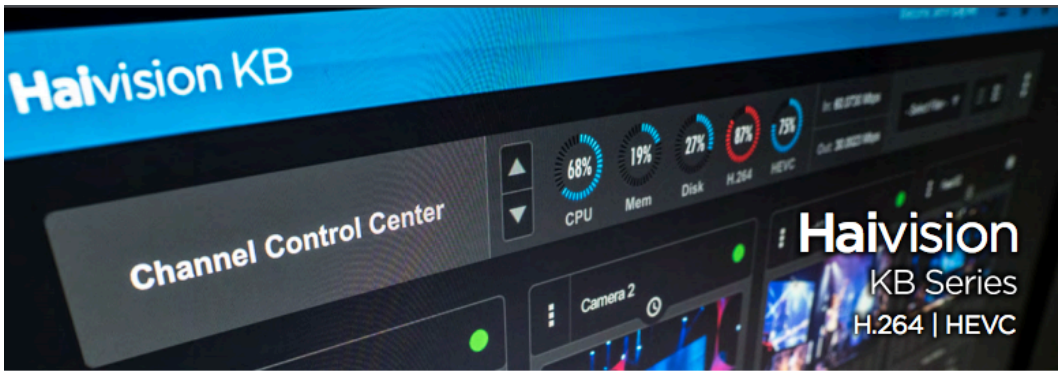
BEST VIEWING EXPERIENCE

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

81. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:



H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

Hardware Acceleration & ABR Cascades The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

Best Viewing Experience on Every Device With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

Get the Most Out of your Uplink Connection to the Cloud When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

Features	Benefits
H.264/HEVC encoding/transcoding	High efficiency video compression over constrained networks for live events contribution
H.264/HEVC ABR Cascades	Seamless viewing experience at the player level with dynamic bitrate/resolution tuning
SRT protocol	AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder
Extensive CDN Support	Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services
608/708 closed captioning	Support digital television closed captioning standards
Small Form Factor (option)	High powered processing in a portable appliance with the KB Mini
360-degree Virtual Reality (option)	Power virtual reality viewing experiences with the KB 4K

82. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

Flexible Deployment Options The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K H.264/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

83. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard"

("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

TechSpecs KB Series

KB ENCODER/TRANSCODER SERIES

Linux-based, optimized for 64-bit computing and *multicore processing*

Validated CDNs:
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

Video Encoding
Video Encoding/Compression Standard:
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
Profiles:
H.264: High, Main, Baseline
HEVC: Main
Bit Rates:
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

Audio Encoding
Compression Standard:
AAC-LC/HE
Bit Rates:
up to 512 Kbps

Network Outputs Protocols
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

File Output
H.264 MP4
HEVC MP4

KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE

Video/Audio Inputs:
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

Stream Outputs:
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimension:
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

Power:
1x External 90W fanless power adapter

Recording storage capacity:
Over 200 GB

KB HD ENCODER/TRANSCODER SERVER

Video/Audio Inputs:
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

Stream Outputs:
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)
Power:
Dual power 550W

System:
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

Audio/Video capture card:
2 Network Interfaces (NIC)

Recording storage capacity:
Over 400 GB

KB 4K ENCODER/TRANSCODER

Video/Audio Inputs:
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

Stream Outputs:
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

With up to four 1080p60 inputs:
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 495W

Recording storage capacity:
Over 400 GB

84. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

KB Product Portfolio & Ordering Information **

KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance	S-KB-SFF2-1	1 baseband capture up to 1080p30 or 1 IP input up to 1080p60
KB Encoder/Transcoder Server	S-KB-1/2/4	KB Enterprise Class H.264 & HEVC SD/HD
KB 4K Encoder/Transcoder	S-KB-4	KB Enterprise Class UHD Encoding/Transcoding Appliance
KB Mini Server Rack - Single Unit	RU-SFF-1	Rack mount for single KB Mini appliance
KB Mini Server Rack - Dual Unit	RU-SFF-2	Rack mount for two KB Mini appliances

85. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:

Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming

MONTREAL, CANADA – APRIL 25, 2017 – Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

86. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with

different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

4. H.264 profiles and levels

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

See https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

Level	Max decoding speed		Max frame size		Max video bit rate for video coding layer (VCL) kbit/s			Examples for high resolution @ highest frame rate (max stored frames) Toggle additional details
	Luma samples/s	Macroblocks/s	Luma samples	Macroblocks	Baseline, Extended and Main Profiles	High Profile	High 10 Profile	
1	380,160	1,485	25,344	99	64	80	192	176×144@15.0 (4)
1b	380,160	1,485	25,344	99	128	160	384	176×144@15.0 (4)
1.1	768,000	3,000	101,376	396	192	240	576	352×288@7.5 (2)
1.2	1,536,000	6,000	101,376	396	384	480	1,152	352×288@15.2 (6)
1.3	3,041,280	11,880	101,376	396	768	960	2,304	352×288@30.0 (6)
2	3,041,280	11,880	101,376	396	2,000	2,500	6,000	352×288@30.0 (6)
2.1	5,068,800	19,800	202,752	792	4,000	5,000	12,000	352×576@25.0 (6)
2.2	5,184,000	20,250	414,720	1,620	4,000	5,000	12,000	720×576@12.5 (5)
3	10,368,000	40,500	414,720	1,620	10,000	12,500	30,000	720×576@25.0 (5)
3.1	27,648,000	108,000	921,600	3,600	14,000	17,500	42,000	1,280×720@30.0 (5)
3.2	55,296,000	216,000	1,310,720	5,120	20,000	25,000	60,000	1,280×1,024@42.2 (4)
4	62,914,560	245,760	2,097,152	8,192	20,000	25,000	60,000	2,048×1,024@30.0 (4)
4.1	62,914,560	245,760	2,097,152	8,192	50,000	62,500	150,000	2,048×1,024@30.0 (4)
4.2	133,693,440	522,240	2,228,224	8,704	50,000	62,500	150,000	2,048×1,080@60.0 (4)
5	150,994,944	589,824	5,652,480	22,080	135,000	168,750	405,000	3,672×1,536@26.7 (5)
5.1	251,658,240	983,040	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@26.7 (5)
5.2	530,841,600	2,073,600	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@56.3 (5)

87. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

88. Based on the bitrate and/or resolution parameter identified (*e.g.* bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of

time for them to compress data than to decompress data. *See*

https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

	Baseline	Extended	Main	High	High 10
I and P Slices	Yes	Yes	Yes	Yes	Yes
B Slices	No	Yes	Yes	Yes	Yes
SI and SP Slices	No	Yes	No	No	No
Multiple Reference Frames	Yes	Yes	Yes	Yes	Yes
In-Loop Deblocking Filter	Yes	Yes	Yes	Yes	Yes
CAVLC Entropy Coding	Yes	Yes	Yes	Yes	Yes
CABAC Entropy Coding	No	No	Yes	Yes	Yes
Flexible Macroblock Ordering (FMO)	Yes	Yes	No	No	No
Arbitrary Slice Ordering (ASO)	Yes	Yes	No	No	No
Redundant Slices (RS)	Yes	Yes	No	No	No
Data Partitioning	No	Yes	No	No	No
Interlaced Coding (PicAFF, MBAFF)	No	Yes	Yes	Yes	Yes
4:2:0 Chroma Format	Yes	Yes	Yes	Yes	Yes
Monochrome Video Format (4:0:0)	No	No	No	Yes	Yes
4:2:2 Chroma Format	No	No	No	No	No
4:4:4 Chroma Format	No	No	No	No	No
8 Bit Sample Depth	Yes	Yes	Yes	Yes	Yes
9 and 10 Bit Sample Depth	No	No	No	No	Yes
11 to 14 Bit Sample Depth	No	No	No	No	No
8×8 vs. 4×4 Transform Adaptivity	No	No	No	Yes	Yes
Quantization Scaling Matrices	No	No	No	Yes	Yes
Separate Cb and Cr QP control	No	No	No	Yes	Yes
Separate Color Plane Coding	No	No	No	No	No
Predictive Lossless Coding	No	No	No	No	No

See http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

H.264 Entropy Coding – Comparison of Approaches

Characteristics	Variable Length Coding (VLC)	Context Adaptive Binary Arithmetic Coding(CABAC)
• Where it is used	MPEG-2, MPEG-4 ASP	H.264/MPEG-4 AVC (high efficiency option)
• Probability distribution	**Static** - Probabilities never change	**Adaptive** - Adjusts probabilities based on actual data
• Leverages correlation between symbols	**No** - Conditional probabilities ignored	**Yes** - Exploits symbol correlations by using "contexts"
• Non-integer code words	**No** - Low coding efficiency forhigh probability symbols	**Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

entropy_coding_mode_flag selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

89. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video data

to provide various compressed data blocks, which can also be organized in a GOP structure.

See https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

Entropy Coding

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

See

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

See http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

90. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

91. On information and belief, Defendant also directly infringe and continue to infringe other claims of the ’442 patent.

92. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

93. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’442 patent.

94. On information and belief, Defendant has had knowledge of the ’442 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendant knew of the ’442 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendant will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’442 patent.

95. Upon information and belief, Defendant’s affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and customary way to infringe the ’442 patent by practicing an apparatus, comprising: a data

decompression system configured to decompress a compressed data block; and a storage medium configured to store at least a portion of the decompressed data block, wherein at least a portion of a data block having video or audio data was compressed with one or more compression algorithms selected from among a plurality of compression algorithms based upon a throughput of a communication channel and a parameter or an attribute of the at least the portion of the data block to create at least the compressed data block, and wherein at least one of the plurality of compression algorithms is asymmetric. For example, Defendant adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendant also induce their customers to use the Accused Instrumentalities to infringe other claims of the '442 patent. Defendant specifically intended and were aware that these normal and customary activities would infringe the '442 patent. Defendant performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the '442 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendant engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendant has induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the '442 patent, knowing that such use constitutes infringement of the '442 patent. Accordingly, Defendant has been, and currently are, inducing infringement of the '442 patent, in violation of 35 U.S.C. § 271(b).

96. Defendant has also infringed, and continue to infringe, claims of the '442 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using

the systems, of the ’442 patent, and constitute a material part of the invention. Defendant know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’442 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendant has been, and currently are, contributorily infringing the ’442 patent, in violation of 35 U.S.C. § 271(c).

97. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendant has injured Realtime and are liable to Realtime for infringement of the ’442 patent pursuant to 35 U.S.C. § 271.

98. As a result of Defendant’s infringement of the ’442 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendant’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

COUNT IV

INFRINGEMENT OF U.S. PATENT NO. 9,762,907

99. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

100. Plaintiff Realtime is the owner by assignment of United States Patent No. 9,762,907 (“the ’907 patent”) entitled “System and methods for video and audio data distribution.” The ’907 patent was duly and legally issued by the United States Patent and Trademark Office on September 12, 2017. A true and correct copy of the ’907 patent

is included as **Exhibit D.**

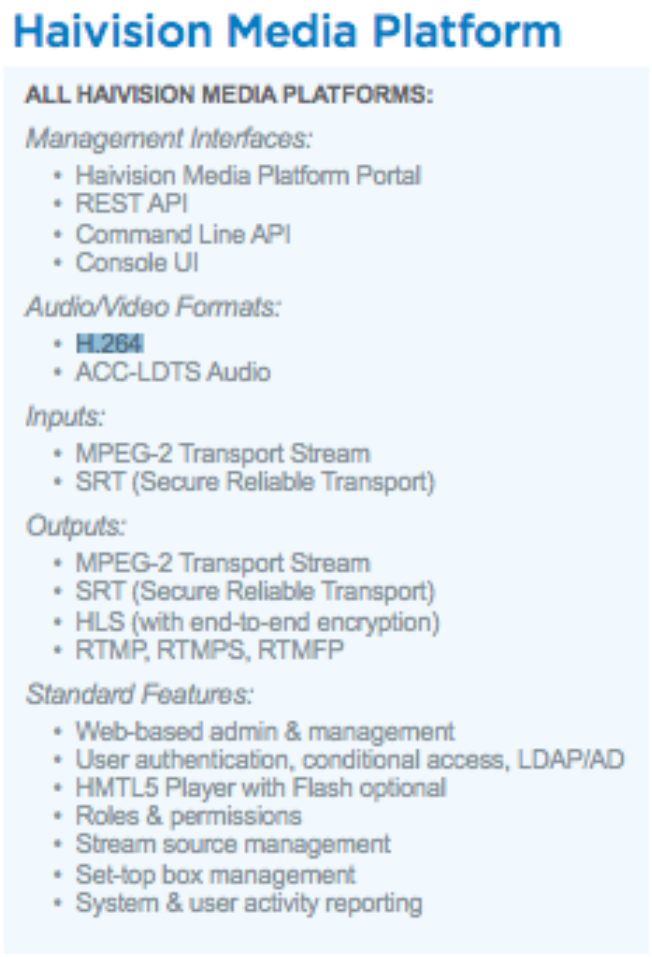
101. On information and belief, Defendant has made, used, offered for sale, sold and/or imported into the United States products that infringe the '907 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendant's video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '907 patent ("Accused Instrumentalities").

102. On information and belief, Defendant has directly infringed and continue to infringe the '907 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the system claimed by Claim 1 of the '907 patent, namely, a system comprising: one or more different asymmetric data compression algorithms, wherein each algorithm of the one or more different asymmetric data compression algorithms utilizes one or more asymmetric data compression routines of a plurality of different asymmetric data compression routines, wherein a first asymmetric data compression routine of the plurality of different asymmetric data compression routines is configured to produce compressed data with a higher data rate for a given data throughput than a second asymmetric data compression routine of the plurality of different asymmetric data compression routines; and a processor configured: to analyze one or more

data parameters from one or more data blocks containing video data, wherein at least one data parameter relates to an expected or anticipated throughput of a communications channel; and to select two or more different data compression routines from among a plurality of different data compression routines based upon, at least in part, the one or more data parameters relating to the expected or anticipated throughput of the communications channel. Upon information and belief, Defendant use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

103. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.,* https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

104. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See* page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:



Haivision Media Platform

ALL HAIVISION MEDIA PLATFORMS:

Management Interfaces:

- Haivision Media Platform Portal
- REST API
- Command Line API
- Console UI

Audio/Video Formats:

- H.264
- ACC-LDTS Audio

Inputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)

Outputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)
- HLS (with end-to-end encryption)
- RTMP, RTMPS, RTMFP

Standard Features:

- Web-based admin & management
- User authentication, conditional access, LDAP/AD
- HMTL5 Player with Flash optional
- Roles & permissions
- Stream source management
- Set-top box management
- System & user activity reporting

105. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):

106. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

High Quality, High Density, High Profile H.264 Encoder & Decoder

Haivision's award-winning Makito X encoder and decoder transports secure, low latency, HD video over any network at extremely low bitrates. Available as an ultra compact SDI or DVI appliance with optional fixed or removable storage, or within a high density 1RU or 4RU chassis. The Makito X is ideal for live, interactive and bandwidth constrained applications.

Highest Quality To maximize video quality over your network, the Makito X supports High Profile H.264 encoding. Tuned to excel in low bandwidth environments, the Makito X gives you twice the quality or uses half the bandwidth compared to other enterprise encoders. Matched with the Makito X Decoder to provide extremely low end-to-end latency, the Makito X delivers pristine quality at sub-2 Mbps bitrates. The Makito X is ideal for video distribution within a facility, to connect facilities or support remote video contribution, to deliver performance video over satellite connections and across the Internet.

107. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Features	Benefits
Low end-to-end latency	Supports mission-critical distribution and interactive communication challenge
4 HD encoding engines	Flexible encoding & compression, adapting to different network environments & applications
Multiple destinations per stream	Target different systems, networks, users, and platforms individually
Highly efficient encoding	Up to twice the quality or half of the bandwidth, using High Profile H.264
12 HD 1080p60 channels in 1RU	Highest density available reducing cost, footprint, and energy consumption
AES 256 bit encryption	Secure unicast or multicast end-to-end video distribution
Metadata support	Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources
SRT and FEC	Maintain video quality over unqualified networks and low cost public internet connections
Integrated with Furnace, InStream and CoolSign	Complete end-to-end video solution

108. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

VIDEO ENCODING/DECODING
Compression Standard:
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
Bit Rates:
SD/HD from 32 kbps to 25 Mbps
Rate Control:
CBR/VBR
Latency (encoder only):
Less than 55ms

IP NETWORK INTERFACES
Standard:
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
Connector:
RJ45
Networking Protocols:
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

109. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at

Makito X Product Portfolio & Ordering Information **

Makito X Single SDI	S/B-292E-HDSDI1	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel
Makito X Dual SDI	S/B-292E-HDSDI2	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels
Makito X DVI	S/B-292E-DVI	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component
Makito X Decoder Single Channel	S/B-292D-HD1	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI
Makito X Decoder Dual Channel	S/B-292D-HD2	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI

http://www3.haivision.com/datasheet-makito-x:

110. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor

MONTREAL and CHICAGO — May 19, 2010 — Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

About Haivision Network Video
Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

111. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

See https://www.haivision.com/products/kb-series/:

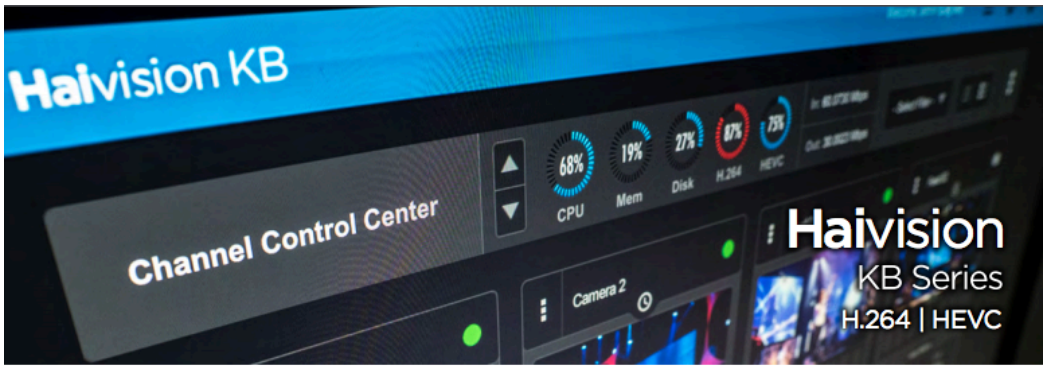
BEST VIEWING EXPERIENCE

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/ MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

112. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:



H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

Hardware Acceleration & ABR Cascades The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

Best Viewing Experience on Every Device With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

Get the Most Out of your Uplink Connection to the Cloud When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

Features	Benefits
H.264/HEVC encoding/transcoding	High efficiency video compression over constrained networks for live events contribution
H.264/HEVC ABR Cascades	Seamless viewing experience at the player level with dynamic bitrate/resolution tuning
SRT protocol	AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder
Extensive CDN Support	Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services
608/708 closed captioning	Support digital television closed captioning standards
Small Form Factor (option)	High powered processing in a portable appliance with the KB Mini
360-degree Virtual Reality (option)	Power virtual reality viewing experiences with the KB 4K

113. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

Flexible Deployment Options The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K H.264/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

114. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard" ("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes

per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

TechSpecs KB Series

KB ENCODER/TRANSCODER SERIES

Linux-based, optimized for 64-bit computing and *multicore processing*

Validated CDNs:
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

Video Encoding
Video Encoding/Compression Standard:
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
Profiles:
H.264: High, Main, Baseline
HEVC: Main
Bit Rates:
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

Audio Encoding
Compression Standard:
AAC-LC/HE
Bit Rates:
up to 512 Kbps

Network Outputs Protocols
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

File Output
H.264 MP4
HEVC MP4

KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE

Video/Audio Inputs:
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

Stream Outputs:
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimension:
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

Power:
1x External 90W fanless power adapter

Recording storage capacity:
Over 200 GB

KB HD ENCODER/TRANSCODER SERVER

Video/Audio Inputs:
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

Stream Outputs:
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)
Power:
Dual power 550W

System:
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

Audio/Video capture card:
2 Network Interfaces (NIC)

Recording storage capacity:
Over 400 GB

KB 4K ENCODER/TRANSCODER

Video/Audio Inputs:
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

Stream Outputs:
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

With up to four 1080p60 inputs:
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 495W

Recording storage capacity:
Over 400 GB

115. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

KB Product Portfolio & Ordering Information **

KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance	S-KB-SFF2-1	1 baseband capture up to 1080p30 or 1 IP input up to 1080p60
KB Encoder/Transcoder Server	S-KB-1/2/4	KB Enterprise Class H.264 & HEVC SD/HD
KB 4K Encoder/Transcoder	S-KB-4	KB Enterprise Class UHD Encoding/Transcoding Appliance
KB Mini Server Rack - Single Unit	RU-SFF-1	Rack mount for single KB Mini appliance
KB Mini Server Rack - Dual Unit	RU-SFF-2	Rack mount for two KB Mini appliances

116. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:

> Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live
>
> *New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming*
>
> **MONTREAL, CANADA – APRIL 25, 2017 –** Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.
>
> The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

117. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

4. H.264 profiles and levels

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

See https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

Level	Max decoding speed		Max frame size		Max video bit rate for video coding layer (VCL) kbit/s			Examples for high resolution @ highest frame rate (max stored frames) Toggle additional details
	Luma samples/s	Macroblocks/s	Luma samples	Macroblocks	Baseline, Extended and Main Profiles	High Profile	High 10 Profile	
1	380,160	1,485	25,344	99	64	80	192	176×144@15.0 (4)
1b	380,160	1,485	25,344	99	128	160	384	176×144@15.0 (4)
1.1	768,000	3,000	101,376	396	192	240	576	352×288@7.5 (2)
1.2	1,536,000	6,000	101,376	396	384	480	1,152	352×288@15.2 (6)
1.3	3,041,280	11,880	101,376	396	768	960	2,304	352×288@30.0 (6)
2	3,041,280	11,880	101,376	396	2,000	2,500	6,000	352×288@30.0 (6)
2.1	5,068,800	19,800	202,752	792	4,000	5,000	12,000	352×576@25.0 (6)
2.2	5,184,000	20,250	414,720	1,620	4,000	5,000	12,000	720×576@12.5 (5)
3	10,368,000	40,500	414,720	1,620	10,000	12,500	30,000	720×576@25.0 (5)
3.1	27,648,000	108,000	921,600	3,600	14,000	17,500	42,000	1,280×720@30.0 (5)
3.2	55,296,000	216,000	1,310,720	5,120	20,000	25,000	60,000	1,280×1,024@42.2 (4)
4	62,914,560	245,760	2,097,152	8,192	20,000	25,000	60,000	2,048×1,024@30.0 (4)
4.1	62,914,560	245,760	2,097,152	8,192	50,000	62,500	150,000	2,048×1,024@30.0 (4)
4.2	133,693,440	522,240	2,228,224	8,704	50,000	62,500	150,000	2,048×1,080@60.0 (4)
5	150,994,944	589,824	5,652,480	22,080	135,000	168,750	405,000	3,672×1,536@26.7 (5)
5.1	251,658,240	983,040	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@26.7 (5)
5.2	530,841,600	2,073,600	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@56.3 (5)

118. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra

coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

119. Based on the bitrate and/or resolution parameter identified (*e.g.* bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of time for them to compress data than to decompress data. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

	Baseline	Extended	Main	High	High 10
I and P Slices	Yes	Yes	Yes	Yes	Yes
B Slices	No	Yes	Yes	Yes	Yes
SI and SP Slices	No	Yes	No	No	No
Multiple Reference Frames	Yes	Yes	Yes	Yes	Yes
In-Loop Deblocking Filter	Yes	Yes	Yes	Yes	Yes
CAVLC Entropy Coding	Yes	Yes	Yes	Yes	Yes
CABAC Entropy Coding	No	No	Yes	Yes	Yes
Flexible Macroblock Ordering (FMO)	Yes	Yes	No	No	No
Arbitrary Slice Ordering (ASO)	Yes	Yes	No	No	No
Redundant Slices (RS)	Yes	Yes	No	No	No
Data Partitioning	No	Yes	No	No	No
Interlaced Coding (PicAFF, MBAFF)	No	Yes	Yes	Yes	Yes
4:2:0 Chroma Format	Yes	Yes	Yes	Yes	Yes
Monochrome Video Format (4:0:0)	No	No	No	Yes	Yes
4:2:2 Chroma Format	No	No	No	No	No
4:4:4 Chroma Format	No	No	No	No	No
8 Bit Sample Depth	Yes	Yes	Yes	Yes	Yes
9 and 10 Bit Sample Depth	No	No	No	No	Yes
11 to 14 Bit Sample Depth	No	No	No	No	No
8×8 vs. 4×4 Transform Adaptivity	No	No	No	Yes	Yes
Quantization Scaling Matrices	No	No	No	Yes	Yes
Separate Cb and Cr QP control	No	No	No	Yes	Yes
Separate Color Plane Coding	No	No	No	No	No
Predictive Lossless Coding	No	No	No	No	No

See http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

H.264 Entropy Coding – Comparison of Approaches

Characteristics	Variable Length Coding (VLC)	Context Adaptive Binary Arithmetic Coding(CABAC)
• Where it is used	MPEG-2, MPEG-4 ASP	H.264/MPEG-4 AVC (high efficiency option)
• Probability distribution	**Static** - Probabilities never change	**Adaptive** - Adjusts probabilities based on actual data
• Leverages correlation between symbols	**No** - Conditional probabilities ignored	**Yes** - Exploits symbol correlations by using "contexts"
• Non-integer code words	**No** - Low coding efficiency forhigh probability symbols	**Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

entropy_coding_mode_flag selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

120. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video data

to provide various compressed data blocks, which can also be organized in a GOP structure.

See https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

Entropy Coding

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

See

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

See http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

121. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

122. On information and belief, Defendant also directly infringe and continue to infringe other claims of the '907 patent.

123. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

124. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the '907 patent.

125. On information and belief, Defendant has had knowledge of the '907 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendant knew of the '907 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendant will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the '907 patent.

126. Upon information and belief, Defendant's affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and customary way to infringe the '907 patent by practicing a system comprising: one or more different

asymmetric data compression algorithms, wherein each algorithm of the one or more different asymmetric data compression algorithms utilizes one or more asymmetric data compression routines of a plurality of different asymmetric data compression routines, wherein a first asymmetric data compression routine of the plurality of different asymmetric data compression routines is configured to produce compressed data with a higher data rate for a given data throughput than a second asymmetric data compression routine of the plurality of different asymmetric data compression routines; and a processor configured: to analyze one or more data parameters from one or more data blocks containing video data, wherein at least one data parameter relates to an expected or anticipated throughput of a communications channel; and to select two or more different data compression routines from among a plurality of different data compression routines based upon, at least in part, the one or more data parameters relating to the expected or anticipated throughput of the communications channel. For example, Defendant adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendant also induce their customers to use the Accused Instrumentalities to infringe other claims of the '907 patent. Defendant specifically intended and were aware that these normal and customary activities would infringe the '907 patent. Defendant performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the '907 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendant engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendant has induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and

customary way to infringe the '907 patent, knowing that such use constitutes infringement of the '907 patent. Accordingly, Defendant has been, and currently are, inducing infringement of the '907 patent, in violation of 35 U.S.C. § 271(b).

127. Defendant has also infringed, and continue to infringe, claims of the '907 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the '907 patent, and constitute a material part of the invention. Defendant know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the '907 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendant has been, and currently are, contributorily infringing the '907 patent, in violation of 35 U.S.C. § 271(c).

128. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities' compression features, Defendant has injured Realtime and are liable to Realtime for infringement of the '907 patent pursuant to 35 U.S.C. § 271.

129. As a result of Defendant's infringement of the '907 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

COUNT V

INFRINGEMENT OF U.S. PATENT NO. 7,386,046

130. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

131. Plaintiff Realtime is the owner by assignment of United States Patent No. 7,386,046 ("the '046 patent") entitled "Bandwidth sensitive data compression and decompression." The '046 patent was duly and legally issued by the United States Patent and Trademark Office on June 10, 2008. A true and correct copy of the '046 patent is included as **Exhibit E.**

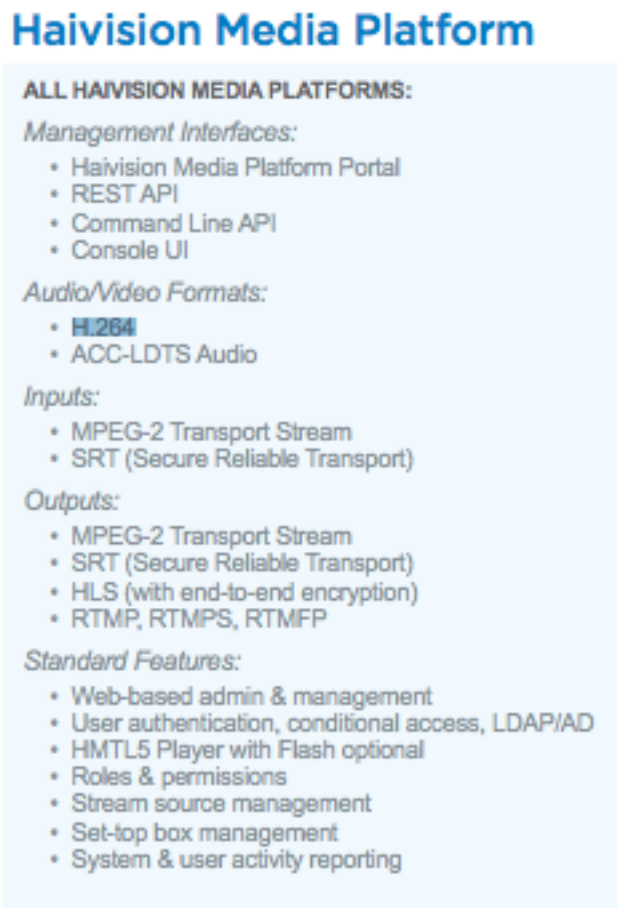
132. On information and belief, Defendant has made, used, offered for sale, sold and/or imported into the United States products that infringe the '046 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendant's video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '046 patent ("Accused Instrumentalities").

133. On information and belief, Defendant has directly infringed and continue to infringe the '046 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the system claimed by Claim 40 of the '046 patent, namely, a system, comprising: a data compression system for compressing and

decompressing data input; a plurality of compression routines selectively utilized by the data compression system, wherein a first one of the plurality of compression routines includes a first compression algorithm and a second one of the plurality of compression routines includes a second compression algorithm; and a controller for tracking throughput and generating a control signal to select a compression routine based on the throughput, wherein said tracking throughput comprises tracking a number of pending access requests to a storage device; and wherein when the controller determines that the throughput falls below a predetermined throughput threshold, the controller commands the data compression engine to use one of the plurality of compression routines to provide a faster rate of compression so as to increase the throughput. Upon information and belief, Defendant use the Accused Instrumentalities to practice infringing methods for its own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

134. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.,* https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

135. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See* page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:



Haivision Media Platform

ALL HAIVISION MEDIA PLATFORMS:

Management Interfaces:

- Haivision Media Platform Portal
- REST API
- Command Line API
- Console UI

Audio/Video Formats:

- H.264
- ACC-LDTS Audio

Inputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)

Outputs:

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)
- HLS (with end-to-end encryption)
- RTMP, RTMPS, RTMFP

Standard Features:

- Web-based admin & management
- User authentication, conditional access, LDAP/AD
- HMTL5 Player with Flash optional
- Roles & permissions
- Stream source management
- Set-top box management
- System & user activity reporting

136. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):

137. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

138. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Features	Benefits
Low end-to-end latency	Supports mission-critical distribution and interactive communication challenge
4 HD encoding engines	Flexible encoding & compression, adapting to different network environments & applications
Multiple destinations per stream	Target different systems, networks, users, and platforms individually
Highly efficient encoding	Up to twice the quality or half of the bandwidth, using High Profile H.264
12 HD 1080p60 channels in 1RU	Highest density available reducing cost, footprint, and energy consumption
AES 256 bit encryption	Secure unicast or multicast end-to-end video distribution
Metadata support	Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources
SRT and FEC	Maintain video quality over unqualified networks and low cost public internet connections
Integrated with Furnace, InStream and CoolSign	Complete end-to-end video solution

139. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

VIDEO ENCODING/DECODING
Compression Standard:
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
Bit Rates:
SD/HD from 32 kbps to 25 Mbps
Rate Control:
CBR/VBR
Latency (encoder only):
Less than 55ms

IP NETWORK INTERFACES
Standard:
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
Connector:
RJ45
Networking Protocols:
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

140. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

Makito X Product Portfolio & Ordering Information **

Makito X Single SDI	S/B-292E-HDSDI1	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel
Makito X Dual SDI	S/B-292E-HDSDI2	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels
Makito X DVI	S/B-292E-DVI	Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component
Makito X Decoder Single Channel	S/B-292D-HD1	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI
Makito X Decoder Dual Channel	S/B-292D-HD2	Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI

141. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor

MONTREAL and CHICAGO — May 19, 2010 — Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

About Haivision Network Video
Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

142. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

See https://www.haivision.com/products/kb-series/:

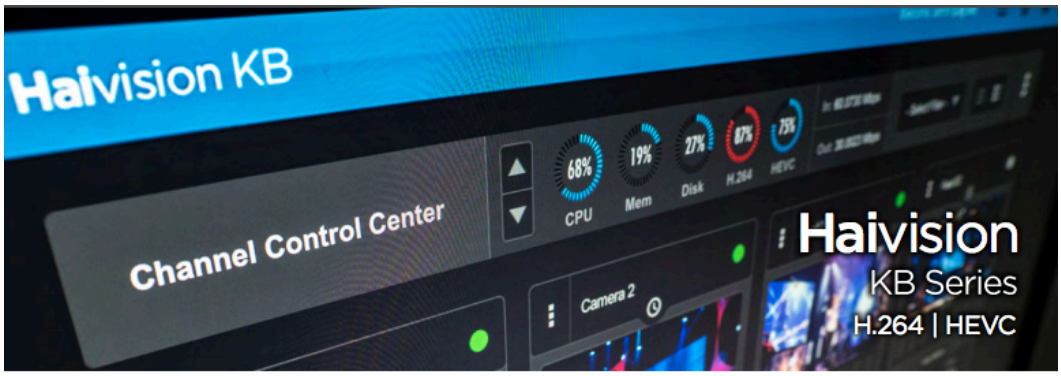
BEST VIEWING EXPERIENCE

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

143. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:



H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

Hardware Acceleration & ABR Cascades The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

Best Viewing Experience on Every Device With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

Get the Most Out of your Uplink Connection to the Cloud When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

Features	Benefits
H.264/HEVC encoding/transcoding	High efficiency video compression over constrained networks for live events contribution
H.264/HEVC ABR Cascades	Seamless viewing experience at the player level with dynamic bitrate/resolution tuning
SRT protocol	AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder
Extensive CDN Support	Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services
608/708 closed captioning	Support digital television closed captioning standards
Small Form Factor (option)	High powered processing in a portable appliance with the KB Mini
360-degree Virtual Reality (option)	Power virtual reality viewing experiences with the KB 4K

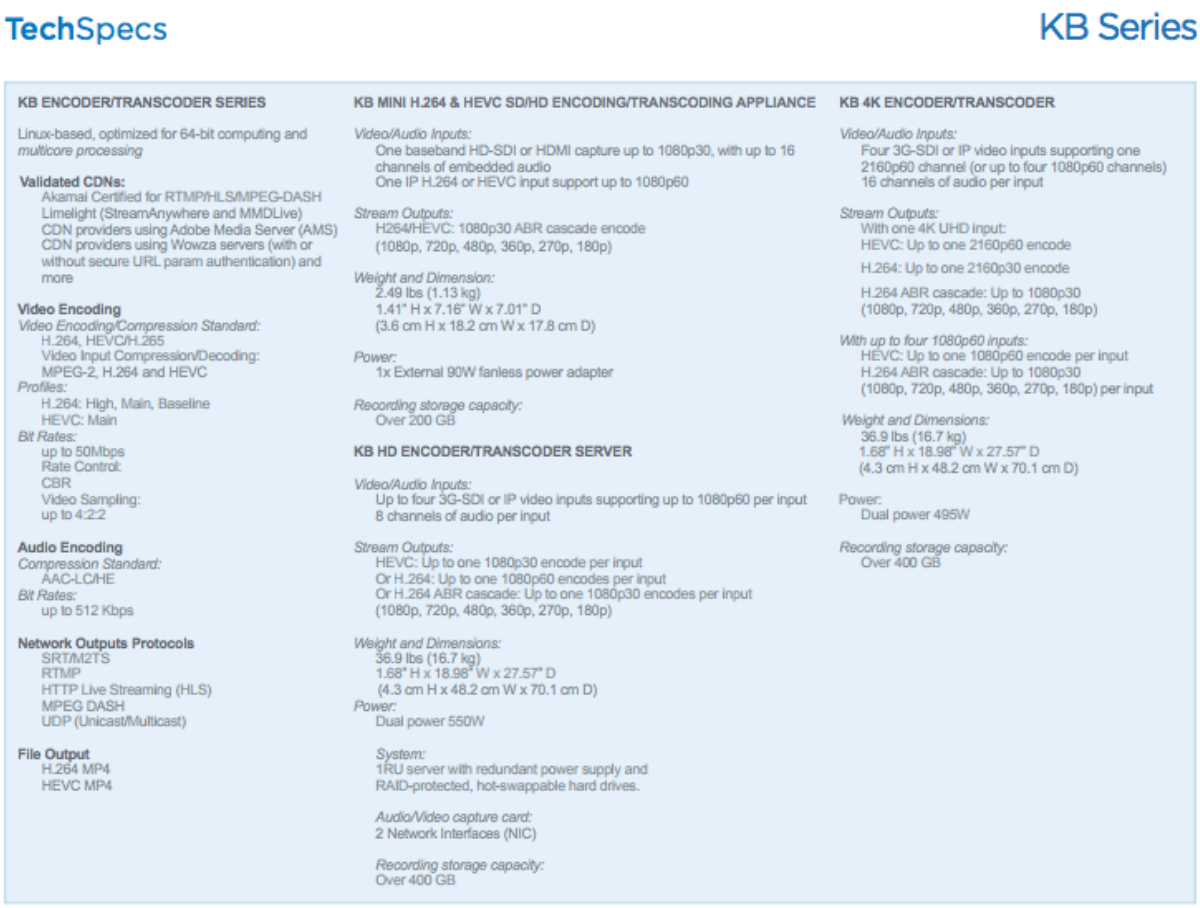
144. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

Flexible Deployment Options The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K H.264/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

145. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard"

("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:



TechSpecs KB Series

KB ENCODER/TRANSCODER SERIES

Linux-based, optimized for 64-bit computing and *multicore processing*

Validated CDNs:
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

Video Encoding
Video Encoding/Compression Standard:
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
Profiles:
H.264: High, Main, Baseline
HEVC: Main
Bit Rates:
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

Audio Encoding
Compression Standard:
AAC-LC/HE
Bit Rates:
up to 512 Kbps

Network Outputs Protocols
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

File Output
H.264 MP4
HEVC MP4

KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE

Video/Audio Inputs:
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

Stream Outputs:
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimension:
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

Power:
1x External 90W fanless power adapter

Recording storage capacity:
Over 200 GB

KB HD ENCODER/TRANSCODER SERVER

Video/Audio Inputs:
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

Stream Outputs:
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)
Power:
Dual power 550W

System:
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

Audio/Video capture card:
2 Network Interfaces (NIC)

Recording storage capacity:
Over 400 GB

KB 4K ENCODER/TRANSCODER

Video/Audio Inputs:
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

Stream Outputs:
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

With up to four 1080p60 inputs:
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 495W

Recording storage capacity:
Over 400 GB

146. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

KB Product Portfolio & Ordering Information **

KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance	S-KB-SFF2-1	1 baseband capture up to 1080p30 or 1 IP input up to 1080p60
KB Encoder/Transcoder Server	S-KB-1/2/4	KB Enterprise Class H.264 & HEVC SD/HD
KB 4K Encoder/Transcoder	S-KB-4	KB Enterprise Class UHD Encoding/Transcoding Appliance
KB Mini Server Rack - Single Unit	RU-SFF-1	Rack mount for single KB Mini appliance
KB Mini Server Rack - Dual Unit	RU-SFF-2	Rack mount for two KB Mini appliances

147. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:

Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming

MONTREAL, CANADA – APRIL 25, 2017 – Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

148. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with

different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

4. H.264 profiles and levels

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

See https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

Level	Max decoding speed		Max frame size		Max video bit rate for video coding layer (VCL) kbit/s			Examples for high resolution @ highest frame rate (max stored frames)
	Luma samples/s	Macroblocks/s	Luma samples	Macroblocks	Baseline, Extended and Main Profiles	High Profile	High 10 Profile	Toggle additional details
1	380,160	1,485	25,344	99	64	80	192	176×144@15.0 (4)
1b	380,160	1,485	25,344	99	128	160	384	176×144@15.0 (4)
1.1	768,000	3,000	101,376	396	192	240	576	352×288@7.5 (2)
1.2	1,536,000	6,000	101,376	396	384	480	1,152	352×288@15.2 (6)
1.3	3,041,280	11,880	101,376	396	768	960	2,304	352×288@30.0 (6)
2	3,041,280	11,880	101,376	396	2,000	2,500	6,000	352×288@30.0 (6)
2.1	5,068,800	19,800	202,752	792	4,000	5,000	12,000	352×576@25.0 (6)
2.2	5,184,000	20,250	414,720	1,620	4,000	5,000	12,000	720×576@12.5 (5)
3	10,368,000	40,500	414,720	1,620	10,000	12,500	30,000	720×576@25.0 (5)
3.1	27,648,000	108,000	921,600	3,600	14,000	17,500	42,000	1,280×720@30.0 (5)
3.2	55,296,000	216,000	1,310,720	5,120	20,000	25,000	60,000	1,280×1,024@42.2 (4)
4	62,914,560	245,760	2,097,152	8,192	20,000	25,000	60,000	2,048×1,024@30.0 (4)
4.1	62,914,560	245,760	2,097,152	8,192	50,000	62,500	150,000	2,048×1,024@30.0 (4)
4.2	133,693,440	522,240	2,228,224	8,704	50,000	62,500	150,000	2,048×1,080@60.0 (4)
5	150,994,944	589,824	5,652,480	22,080	135,000	168,750	405,000	3,672×1,536@26.7 (5)
5.1	251,658,240	983,040	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@26.7 (5)
5.2	530,841,600	2,073,600	9,437,184	36,864	240,000	300,000	720,000	4,096×2,304@56.3 (5)

149. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (e.g. bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

150. Based on the bitrate and/or resolution parameter identified (e.g. bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (e.g., "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of

time for them to compress data than to decompress data. *See*

https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

	Baseline	Extended	Main	High	High 10
I and P Slices	Yes	Yes	Yes	Yes	Yes
B Slices	No	Yes	Yes	Yes	Yes
SI and SP Slices	No	Yes	No	No	No
Multiple Reference Frames	Yes	Yes	Yes	Yes	Yes
In-Loop Deblocking Filter	Yes	Yes	Yes	Yes	Yes
CAVLC Entropy Coding	Yes	Yes	Yes	Yes	Yes
CABAC Entropy Coding	No	No	Yes	Yes	Yes
Flexible Macroblock Ordering (FMO)	Yes	Yes	No	No	No
Arbitrary Slice Ordering (ASO)	Yes	Yes	No	No	No
Redundant Slices (RS)	Yes	Yes	No	No	No
Data Partitioning	No	Yes	No	No	No
Interlaced Coding (PicAFF, MBAFF)	No	Yes	Yes	Yes	Yes
4:2:0 Chroma Format	Yes	Yes	Yes	Yes	Yes
Monochrome Video Format (4:0:0)	No	No	No	Yes	Yes
4:2:2 Chroma Format	No	No	No	No	No
4:4:4 Chroma Format	No	No	No	No	No
8 Bit Sample Depth	Yes	Yes	Yes	Yes	Yes
9 and 10 Bit Sample Depth	No	No	No	No	Yes
11 to 14 Bit Sample Depth	No	No	No	No	No
8×8 vs. 4×4 Transform Adaptivity	No	No	No	Yes	Yes
Quantization Scaling Matrices	No	No	No	Yes	Yes
Separate Cb and Cr QP control	No	No	No	Yes	Yes
Separate Color Plane Coding	No	No	No	No	No
Predictive Lossless Coding	No	No	No	No	No

See http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

H.264 Entropy Coding – Comparison of Approaches

Characteristics	Variable Length Coding (VLC)	Context Adaptive Binary Arithmetic Coding(CABAC)
• Where it is used	MPEG-2, MPEG-4 ASP	H.264/MPEG-4 AVC (high efficiency option)
• Probability distribution	**Static** - Probabilities never change	**Adaptive** - Adjusts probabilities based on actual data
• Leverages correlation between symbols	**No** - Conditional probabilities ignored	**Yes** - Exploits symbol correlations by using "contexts"
• Non-integer code words	**No** - Low coding efficiency forhigh probability symbols	**Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

entropy_coding_mode_flag selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

151. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video data

to provide various compressed data blocks, which can also be organized in a GOP structure.

See https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

Entropy Coding

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

See

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

See http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

152. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

153. On information and belief, Defendant also directly infringe and continue to infringe other claims of the ’046 patent.

154. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, e.g., in the manner specified in the H.264 standard.

155. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’046 patent.

156. On information and belief, Defendant has had knowledge of the ’046 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendant knew of the ’046 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendant will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’046 patent.

157. Upon information and belief, Defendant’s affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and customary way to infringe the ’046 patent by practicing a system, comprising: a data compression

system for compressing and decompressing data input; a plurality of compression routines selectively utilized by the data compression system, wherein a first one of the plurality of compression routines includes a first compression algorithm and a second one of the plurality of compression routines includes a second compression algorithm; and a controller for tracking throughput and generating a control signal to select a compression routine based on the throughput, wherein said tracking throughput comprises tracking a number of pending access requests to a storage device; and wherein when the controller determines that the throughput falls below a predetermined throughput threshold, the controller commands the data compression engine to use one of the plurality of compression routines to provide a faster rate of compression so as to increase the throughput. For example, Defendant adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendant also induce their customers to use the Accused Instrumentalities to infringe other claims of the '046 patent. Defendant specifically intended and were aware that these normal and customary activities would infringe the '046 patent. Defendant performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the '046 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendant engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendant has induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the '046 patent, knowing that such use constitutes infringement of the '046 patent. Accordingly, Defendant has been, and currently are, inducing infringement of the '046 patent, in violation of 35 U.S.C. § 271(b).

158. Defendant has also infringed, and continue to infringe, claims of the ’046 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the ’046 patent, and constitute a material part of the invention. Defendant know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’046 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendant has been, and currently are, contributorily infringing the ’046 patent, in violation of 35 U.S.C. § 271(c).

159. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendant has injured Realtime and are liable to Realtime for infringement of the ’046 patent pursuant to 35 U.S.C. § 271.

160. As a result of Defendant’s infringement of the ’046 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendant’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff Realtime respectfully requests that this Court enter:

a. A judgment in favor of Plaintiff that Defendant has infringed, literally and/or under the doctrine of equivalents, the ’535, ’477, ’442, ’907, and ’046 patents (the “Asserted Patents”);

b. A judgment and order requiring Defendant to pay Plaintiff its damages, costs, expenses, and prejudgment and post-judgment interest for its infringement of the Asserted Patents, as provided under 35 U.S.C. § 284;

c. A judgment and order requiring Defendant to provide an accounting and to pay supplemental damages to Realtime, including without limitation, prejudgment and post-judgment interest;

d. A permanent injunction prohibiting Defendant from further acts of infringement of the Asserted Patents;

e. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Plaintiff its reasonable attorneys' fees against Defendant; and

f. Any and all other relief as the Court may deem appropriate and just under the circumstances.

DEMAND FOR JURY TRIAL

Plaintiff, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

July 23, 2019

/s/ Reza Mirzaie

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